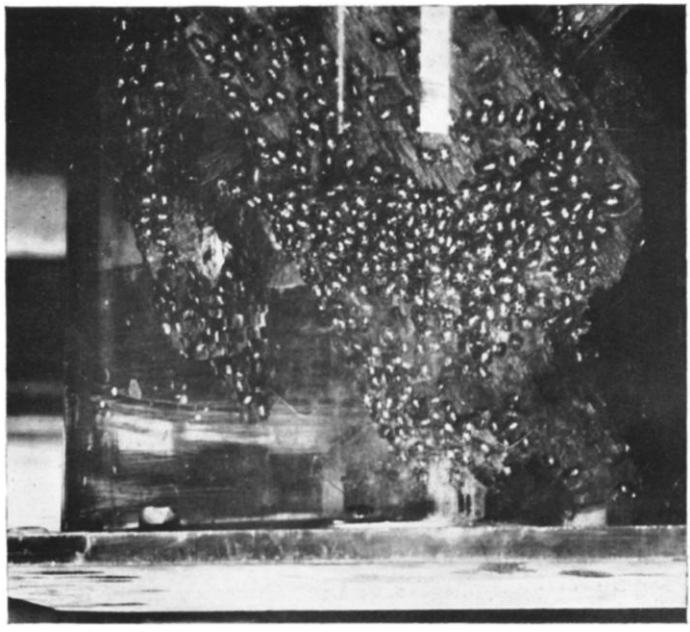
NATURE WORK IN THE SCHOOLROOM

ROBERT K. NABOURS
The School of Education

In studying live forms, both animal and plant, out in the field, the best possible equipment is the possession of the proper spirit—the abiding interest in the forms, and their varied relations to each other, to their environment, and to man. It is often found that if there be enough interest to induce a start, the larger abiding interest will develop.

To be in a hurry is a very bad thing, since nature does not sensibly pose for the benefit of the student. The forms do not arrange the times and places for displaying their breathing, feeding, breeding, hibernating, and æstivating habits and adaptations and wonderful stages of metamorphoses for the convenience of human beings, unless other than natural forces be brought to bear. Conditions of food and temperature largely determine these matters, and when one meets a favorable condition for observation, he must be prepared to stop and watch the processes, if he would see them. It is fortunate that the number and variety of interesting forms, and the places of their living, are very great, so that one may not pass through any strip of woods or marsh at any time of the year without seeing something worth observing, even if his time be limited.

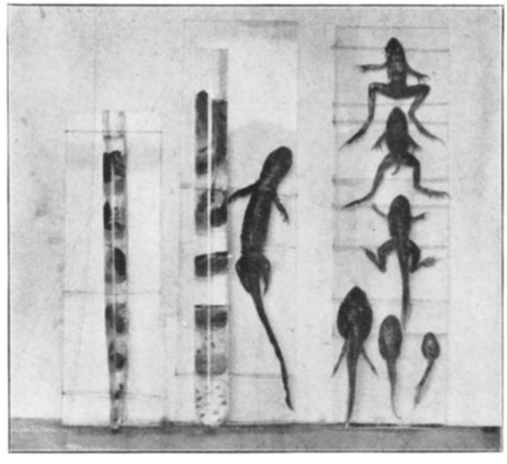
However, there are many phases which cannot be thoroughly studied in the field, even if one should have much time at his disposal, but which may be brought in and observed under very natural conditions in the laboratory, where the whole school may have the benefit of the experiences, with little interruption of the regular activities. The whole school, however, should have a hand in gathering from their natural habitats the forms thus to be studied. Unless this be done, a valuable feature of the work will be lost. Besides, this material may be collected while



LADY BEETLES HIBERNATING

BUTTERFLIES AS SCAVENGERS

A WINTER FIELD TRIP



LIFE HISTORIES—FROG, SALAMANDER, AND WATER BUG

the students are on trips of observation of forms and areas and conditions which may better be studied in the field.

The life of ponds and streams is probably the most readily adapted for study in the schoolroom, as the conditions may be kept very nearly as they are in nature. In the aquaria stocked with plants and animals from the near-by swamps one may observe, from day to day and from month to month, the cycles of life as they develop and disappear or are displaced. The plants secure their subsistence from the decaying matter, water, and air; the lower animals—protozoa, crustaceans, etc.—feed upon the plants, and in turn are eaten by the higher forms; and these in turn live out their time and die, or the weaker succumb to the stronger, and their bodies again contribute to the plants and lower animal forms, and thus the cycle is completed. There are necessarily many animal forms which cannot be kept in the same aquarium, and the beginner will be dismayed with a good many accidents till he learns which forms have to be segregated. The principle of the "survival of the fittest" will manifest itself frequently.

A few Mason jars with tops which may be screwed on water-tight, a bag for carrying them, and a strong home-made net, will make up the necessary outfit for the field trip. A slowly running ditch, or a pond which has considerable algæ and pond-weed growing in it, will furnish the material. A few dips with the net into the water should be made, and the general contents of animal and plant life emptied into a water-filled jar. The jar may be crammed pretty full, the top screwed on tightly, and then placed in the bag, to be emptied into more water in an aquarium as soon as possible after the return to the laboratory.

In caring for an aquarium so stocked it may be necessary to change the water a few times and to take out some of the decayed matter; but if there be plenty of algæ and other plants, it usually clears up without help. Plenty of pond-weed and algæ should be kept in all aquaria, whether they be used for general observation or for the study of particular forms.

The possibilities for interesting and instructive study of aquaria so arranged are limitless. One may secure many helpful

suggestions from several books and papers which have been published on the subject. The most helpful probably are Furneaux's *Life in Ponds and Streams* and Stoke's *Aquatic Microscopy*. Books on special forms and groups of forms should be consulted frequently, and there are many of these. The several volumes of the Cambridge *Natural History,* Miall's *Aquatic Insects,* Sedgwick and Wilson's *General Biology,* and Calkins' *Protozoa* are especially good. But hundreds of interesting observations which are not recorded in any book, and, in fact, some entirely new observations will most likely be made. A list of a few of the most probable observations may not be out of place: the manner of feeding, respiring, and breeding of hydra, cyclops, leeches, snails, the various larvæ of higher forms, beetles, and bugs, and the respiration and growth of algæ and other water plants. The study of the life-histories and habits of individual forms may be carried to any extent which the time and inclination of the teachers and pupils will admit. It is possible to give directions for the study of only a few in this paper.

The salamander.—During the last days of March or the first of April, in almost any small pond in a marshy area, one may find the eggs of our common *Amblystoma tigrinum,* one of the salamander group. They are very similar to those of a frog, except that the bunches are much smaller, being attached to weeds or bushes in the water in bunches a little larger than the thumb. Several bunches should be placed in a jar of water and taken to the laboratory, where in the ordinary temperature of the room they will hatch within a few days. They are carnivorous, and young tadpoles make choice food for them; so, some frog eggs should be hatched out in the same aquarium and at about the same time as those of the *Amblystoma.* When other food is scarce, they readily eat one another. The following account will to some extent describe their habits: About April 1, 25–40 *Amblystoma* eggs were hatched in an aquarium, and within a week 75–100 frog eggs were hatched in the same place. A few days later the *Amblystoma* larvæ (axolotls) were observed to be eating the tadpoles; but as there was much vegetable matter in the jar, the tadpoles soon became too large for their enemies.

By May 1, the *Amblystomæ* were seen to be eating one another, and this cannibalism continued till May 15 when but one fine large axolotl survived, and it was then able to eat the remaining tadpoles, 15 or 20 in number, by June 10.

For the purpose of saving stages in the life-history of the *Amblystoma,* it is well to have four or five of the larvæ in each of three or four jars. If tadpoles are not available for the later stages of the larvæ, insects, worms, or bits of meat may be fed to them. Much care, however, must be observed in using meat in any aquarium, as it is very easy to contaminate the water. When the axolotls have well-developed legs, they should be placed in a vessel with sand sloping up out of the water, so that, as the gills are lost and lungs are developed, the adult may crawl out of the water. The adult should be kept in a dark, moist place, and fed about the same as the larvæ.

The frog.—The life-history of the frog or toad is much easier to work out than that of the salamander, as they are omnivorous, eating anything from growing plants to decaying meat. It is probably better not to have anything in the aquarium with them for the first few weeks, except the usual plant forms; but pieces of bone and gristle should be provided for the later stages, and they will rasp off the softer parts. Persons engaged in cleaning and mounting skeletons sometimes use them in great numbers for cleaning the bones.

The water-bug.—The smaller water bug, *Zaitha,* is peculiar in its manner of breeding in that the female seizes the unwilling male, after a vigorous chase, and attaches her eggs on and all over his back. A specimen thus covered was secured early in August and placed in an aquarium, and within a few days a dozen or more young were hatched. The parent and two of the young were then killed and placed in formalin; the remaining young were allowed to grow, and about every ten days a specimen was taken out and preserved, till seven stages, from the egg to the adult male with the eggs on his back, were ready to mount permanently. The growing young frequently molted, and it was not easy to distinguish the molt, so perfect were they, from the dead specimens. The young *Zaithæ* are

carnivorous, feeding on young of small crustaceans and snails by thrusting their beak like mouths into the body and sucking out the juices.

The bladderwort (Utricularia vulgaris).—This is one of the most common plants found in our ponds and sluggish streams, and it is one of the best to grow in the aquaria. It is very interesting in that it is carnivorous, feeding upon protozoa and small crustaceans which enter through trap doors into the pouch-like bladders at the bases of the leaves which are characteristic of this plant. During the spring and summer it reaches a length of several feet and floats around unattached in the water. In the late fall thick, dense buds are formed at the ends of the branches, ranging from the size of a pea to that of the thumb. These buds contain all the elements of the plant which is to come out the next spring. The greater portion of the bud appears to be composed of the long, slender leaves arranged longitudinally and very compactly together. In late November, when the buds are well covered with the slime from the decay of the surrounding vegetation, they are detached by their weight from the dead mother-plant, and sink to the bottom of the pond or stream, where they remain safely till the warmth of the spring causes them to expand and rise to the surface again, where they soon produce new plants. If these buds be brought in late in the fall, they soon open in the warm temperature of the room, and are excellent for keeping the aquaria in condition during the winter.

It was observed, upon tearing open some of the buds brought in late in December, that a great many small crustaceans, cypris, etc., were attached to them, or had crawled in among the longitudinally fitting leaves. This seems to indicate that these forms find the slime around the buds and, their interior substance, convenient places in which to spend the winter. Not only, therefore, does the plant perpetuate itself by the formation of these buds and through their habit of sinking, it also carries safely through the winter the very animal forms upon which it feeds during its growing season.